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Seasonal and local differences in the weight of European badgers (*Meles meles* L.) in relation to food supply

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Abstract

Studied were the weights of badgers *Meles meles* in the wild and in captivity. All animals were lighter in summer than in winter, despite the fact that captive badgers had food ad libitum. Captive badgers were heavier than wild ones, badgers from southern England were heavier than those from Scotland, and badgers from eastern Scotland heavier than those from the west. It is argued that the seasonal weight fluctuations occur independently of food supply, but differences between regions may be caused by food availability.

Introduction

The weights of wild European badgers (*Meles meles* L.) fluctuate more or less predictably with the seasons; here we describe an experiment which shows that this annual variation is independent of the availability of the badgers' natural foods.

In studies of mammalian ecology, the weight of animals is often used as an indicator of "condition", and linked to their chances of survival (review in HANKS 1981). Body weight is in many species closely related to nutritive status and food supply (KLEIN 1970; HANKS 1981). An increase in body weight in autumn and corresponding decrease in winter and spring, is known for several carnivores, e.g. bears (FOLK et al. 1972) and raccoon (MECH et al. 1968).

In the badger annual weight fluctuations have been noted by several authors (e.g. SOUTHERN 1977; NEAL 1977). In Britain the species feeds mostly on earthworms (SOUTHERN 1977; KRUUK 1978; KRUUK and PARISH 1981), which are more difficult to obtain during the dry summer months (KRUUK 1978), and this paper describes a test of the possibility that the badgers' low summer weight is caused by a shortage of food at that time of year. The opportunity to investigate this arose when we could, over a period of six years, weigh badgers which were kept in a large enclosure with a natural vegetation, and under natural climatic conditions, but with a controlled supply of food. If annual weight fluctuations of wild badgers were caused by variation in food availability, we would expect

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badgers with year-round access to an ample supply of food to show no such weight fluctuations. In addition, we compared weights of badgers from different areas in Britain and discuss these against a background of known differences in food supply in these areas.

Methods

Badgers were kept in a 40 m × 40 m enclosure in an area of natural birch woodland near Banchory, N.E. Scotland. The vegetation inside the enclosure consisted of birch (*Betula* spp.), rowan (*Sorbus aucuparia*), broom (*Cytisus scoparius*), bracken (*Pteridium aquilinum*), blackberry (*Rubus* spp.) and various grasses. It was surrounded by a 1.5 m high chain-link fence; badgers had dug a large sett with about 8 entrances inside, but often preferred to sleep in the basement of a small house which was connected with the enclosure through an 8 m long, 30 cm diameter concrete tunnel. In 1976 there were three badgers in this enclosure, increasing to 8 in 1982 through reproduction; over the years several badgers had to be removed because of internal strife in the group, and two animals died. The animals were effectively wild, but were fed daily, mostly with dead day-old chicks, supplemented with peanuts or crushed barley, and with dead rabbits. Food presented to them was almost always slightly more than the badgers consumed. The enclosure itself provided some invertebrate food but probably in negligible quantities. Information on the badgers' weights was collected in two ways. Firstly, the animals were caught at irregular intervals, using a hypodermic dart with ketamine hydrochloride (25 mg/kg body weight) administered from a blowpipe. They were then weighed, using a Salter spring-balance, and released. Secondly, observations were collected using unrestrained badgers which walked onto a 1 m × 1 m aluminium platform suspended close to the ground from a Salter spring-balance; the badgers ate some peanuts on the platform and weight could be read from the observation hut above it. Weights of wild badgers were routinely collected during catching of badgers for radio-tracking studies in Wytham Woods, Oxford (Kruuk 1978) and in Scotland (Kruuk and Parish 1982; Parish and Kruuk 1982). Only information from badgers of over one year old is considered.

Results

Weights of wild badgers are presented in Fig. 1; our own data have been augmented with data extracted from Neal and Harrison (1958) of badgers killed in Devon and Somerset. In summer the animals are lighter than in winter, although the timing of the lowest point in the graph is different for the various categories. Using median tests (Siegel 1956) female badgers from Wytham and from Devon/Somerset are significantly lighter around the middle of the year (May–July; Fischer test, $p < 0.025$ for Wytham, $X^2 = 8.17$, $p < 0.01$ for Devon/Somerset), but males from Wytham are not (Fisher test, $p > 0.05$): they are significantly lighter in the July–October period (Fisher, $p < 0.005$). The number of observations on wild males is only small, however, and insufficient to draw conclusions about the exact timing of weight differences.

The captive badgers, with free access to food, showed similar seasonal fluctuations (Fig. 2); in May–July they were significantly lighter than at other times (♀♀: $X^2 = 9.77$, $p < 0.01$; ♂♂: $X^2 = 3.98$, $p < 0.05$). We did not measure actual food intake by the badgers,

Table

Weights of badgers from three areas in Northern Scotland

Mean weight in kgs. ± s.d.	West Coast (near Arisaig)	North-Central (near Aviemore)	East Coast (near Peterhead)
♂♂	8.4 ± 0 (n = 2)	8.8 ± 1.4 (n = 14)	10.4 ± 0.9 (n = 6)
♀♀	6.7 ± 0.7 (n = 4)	8.0 ± 1.2 (n = 17)	9.6 ± 1.5 (n = 11)

Statistical evaluation: ♂♂, East coast versus North-Central: $U = 16$, $p < 0.025$; ♀♀, East Coast versus North-Central: $U = 41.5$, $p < 0.025$; North-Central, ♂♂ versus ♀♀: $U = 82.5$, $p < 0.05$; East Coast, ♂♂ versus ♀♀: $U = 18.5$, $p < 0.05$.

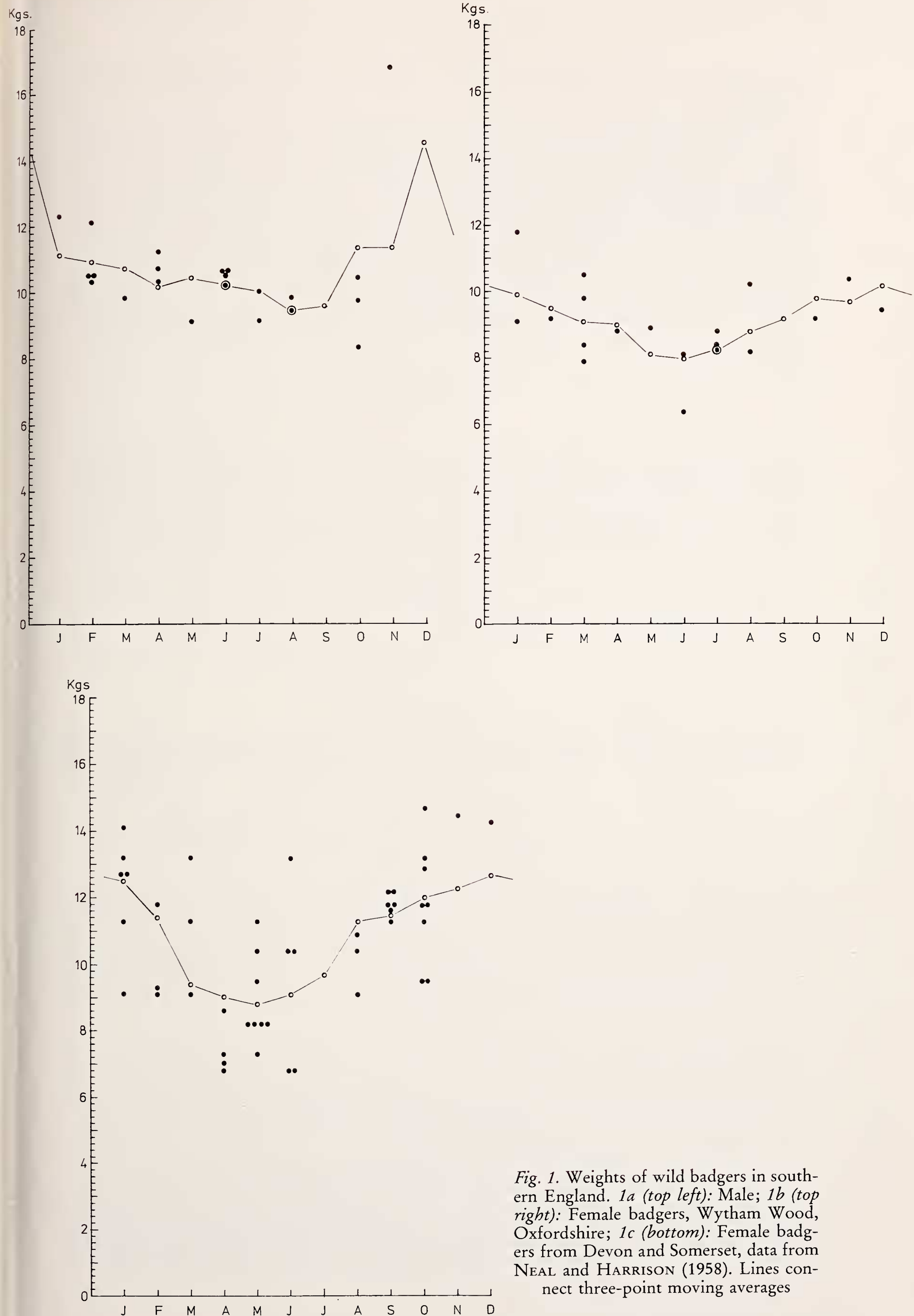

Fig. 1. Weights of wild badgers in southern England. *1a (top left):* Male; *1b (top right):* Female badgers, Wytham Wood, Oxfordshire; *1c (bottom):* Female badgers from Devon and Somerset, data from NEAL and HARRISON (1958). Lines connect three-point moving averages

but the overall impression was that the captive badgers ate less in summer than in spring or autumn.

There were differences between the various categories of badgers in their average weights; for instance, female badgers collected by NEAL and HARRISON (1958) had a median weight of 10.9 kg, the females from Wytham only 8.4 kg ($X^2 = 14.3$, $df = 2$, $p < 0.001$). Captive females were significantly heavier than the Devon/Somerset females still, with a median weight of 12.6 kg ($X^2 = 14.6$, $df = 2$, $p < 0.001$; data for the captive animals treated as independent of each other). Captive males were heavier than captive females, with a median weight of 14.4 kg ($X^2 = 31.2$, $df = 2$, $p < 0.001$), and amongst wild badgers in Wytham males were heavier than females (median 10.4 kg as compared with 8.4 kg, $X^2 = 66.4$, $df = 1$, $p < 0.01$). In Scotland we found indications that the weight of badgers increased from west to east (Table); there were significant differences between our study areas.

Discussion

Our observations on the weights of badgers which had access to a surfeit of food show that the seasonal fluctuations in weights of wild badgers need not be related to food availability. A factor other than food must be important, a physiological mechanism triggered perhaps by the change in daylight, or temperature.

The seasonal weight fluctuations are probably mostly caused by fluctuations in the

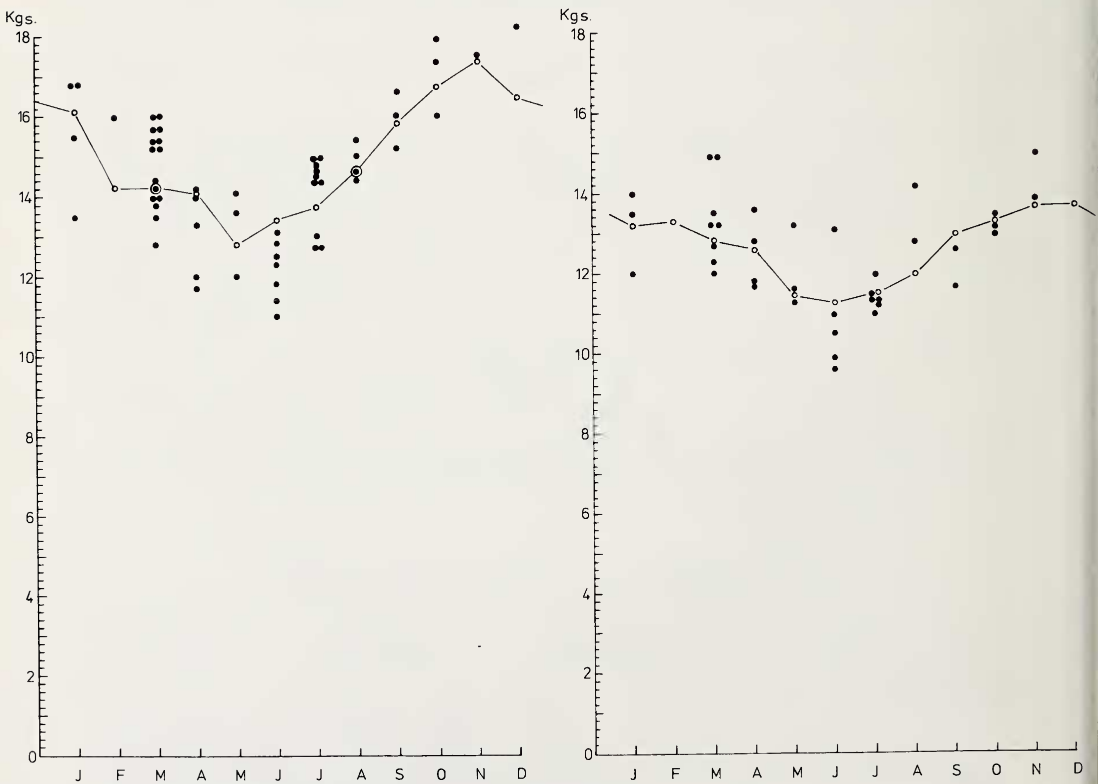

Fig. 2. Weights of captive badgers in semi-natural environment. *2a (left):* Males, *2b (right):* Females. Lines connect three-point moving averages

amount of fat, stored subcutaneously as well as intertestinally and around the kidneys (H. Ahnlund, pers. comm.; own observations). Badgers forage little in late autumn and winter, on many days not at all, even though there may be much food around including earthworms (unpublished observations); the animals must be metabolising their fat then. On the other hand, our present data suggest that in the summer months badgers do not put on fat, despite a surfeit of food. It could be that this surfeit of food is only apparent, and that the shorter length of the night causes shorter foraging times, therefore a decrease in food intake. However, the captive badgers tend to eat their food in a fairly short time, 1–2 hrs at most, and in summer often do so when it is still daylight; at all seasons, foraging occupies a relatively small part of the animals' time. It is possible also that there is an increase in metabolic rate in the summer, independent of food intake; we have no evidence of this, but as the animals are more active in early spring and in autumn this seems not very likely. European badgers also do not cache food (unpublished observations) unlike many other Mustelids, including the American badger *Taxidea taxus* (Snead and Hendrickson 1942). We conclude, therefore, that at least during the summer badgers do not fully utilize the available resources.

All this does not mean, of course, that other observed differences in weight between badgers are not induced by resource availability. There can be little doubt that in times of food stress badgers do not put on as much fat as in times of plenty. Probably, the fact that captive badgers are heavier (Neal 1977; this paper), whether due to fat or skeletal differences, is related to differences in food availability. This may also explain the variation in body weight between our Scottish study areas (Table); there was a large increase in the availability of earthworm biomass per badger when going from west to east coast in Scotland (Kruuk and Parish 1981). A similar difference in food availability (e.g. the very short nights in summer in Scotland) could be responsible for the overall differences in body weight between north and south in Britain.

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Zusammenfassung

Saisonale und regionale Unterschiede im Gewicht von Dachsen (Meles meles L.) in Beziehung zum Nahrungsangebot

Die Gewichte freilebender und in Gefangenschaft gehaltener Dachse *(Meles meles)* wurden in Abhängigkeit von der Jahreszeit verglichen. Freilebende wie gefangengehaltene Dachse waren im Sommer leichter als im Winter. Dies kann nicht auf unterschiedlichem Nahrungsangebot beruhen, da die gefangenen Dachse stets im Überfluß zu fressen hatten. Sie erreichten höhere Gewichte als freilebende Dachse, und Tiere aus Südengland wurden schwerer als schottische. Dachse aus Ostschottland wogen mehr als westschottische. Im Gegensatz zu den jahreszeitlichen Gewichtsschwankungen könnten die regionalen durch ein unterschiedliches Nahrungsangebot verursacht werden.

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The effect of seal hunting in Germany on the further existence of a harbour seal population in the Dutch Wadden Sea

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Abstract

Calculated influence of dispersal and hunting pressure on seals in the Wadden Sea. Due to pollution effects pup production in the Dutch seal population is too low compared to the stable population in Schleswig-Holstein. Nevertheless, aerial surveys showed that the total number of seals remained fairly stable at about 500 specimens since 1974. It is demonstrated that since hunting was stopped in Niedersachsen and Schleswig-Holstein unrestricted dispersal in the Wadden Sea area could take place. It is calculated that the Dutch seal population in 1980 contained 41 % animals originating from outside the area. Besides another 15 % of the animals were repatriated by seal nursery stations. Abstinence of hunting in the whole area is of vital importance for the further existence of a harbour seal population in the Dutch Wadden Sea.

Introduction

The stock of harbour seals occurring in the Wadden Sea area (Fig. 1) has to be considered as one population. Tagging of young seals within the area (Wipper 1975; Drescher 1979; van Haaften, pers. comm.) and outside the area (e.g. Bonner and Witthames 1974) showed that random dispersal occurs within the Wadden Sea but exchange with other areas is negligible. However, the large estuaries of the rivers Ems and Elbe and the Hindenburg dam to Sylt act as geographical barriers and therefore it is assumed that with respect to mature seals four "sub" populations can be distinguished.

Regular aerial surveys showed that at least since 1960 the total number of seals in the Wadden Sea decreased, although since 1973 a slight increase is noted (Reijnders 1981). Studies on population dynamics carried out in The Netherlands (Reijnders 1978) revealed that compared to the fairly stable population in Schleswig-Holstein pup production in the Dutch seal population is too low (Fig. 1). This is probably caused by pollution (Reijnders

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